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Aspen

An American Wood

Aspen, the most widely distributed tree species in North America, is one of the softer and lighter weight commercial hardwoods in the United States. The largest volumes of aspen are used in the manufacture of pulp products such as book and specialty papers, newsprint, and insulation board; it is the preferred species for the manufacture of structural flake board. The wood is light in color, straight grained, finely textured, and odorless and tasteless when dried. It resists splitting when nailed, has excellent gluing character, and is free from slivers, making it ideal for furniture parts and interior trim, as well as boxes, crating, pallets, and lumber core stock. Smaller volumes are used for excelsior, particle board, paper roll plugs, and turned products.

Aspen
(*Populus tremuloides* Michx. and *Populus grandidentata* Michx.)

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Distribution

Two species of aspen grow in North America, quaking and bigtooth. Where their ranges overlap, both species may be present in the same stand. Often, aspen stands contain fir, spruce, paper birch, or other species.

Quaking aspen, the most widely distributed tree species in North America (fig. 1), ranges from Alaska through Canada and into the Northeastern and Western United States. In the West it occurs as far south as central Mexico at elevations where moisture is adequate and summers are sufficiently cool. The more restricted range of bigtooth aspen (fig. 2) includes southern Canada and the Northern United States, from the Atlantic Coast westward to the prairie.

Five of the States have more than 2 million acres of aspen stands on commerical forest land:[2]

State	Acres
Minnesota	5,302,000
Wisconsin	3,665,000
Michigan	3,407,000
Colorado	2,854,000
Alaska	2,407,000
Maine	819,000
Utah	717,000

In Minnesota, Wisconsin, and Utah, aspen stands occupy more land than any other forest type, and very large acreages are found in Canada, especially the central portion.

Aspen trees commonly occur in many other forest types too, especially the spruce and fir types of the Lake States

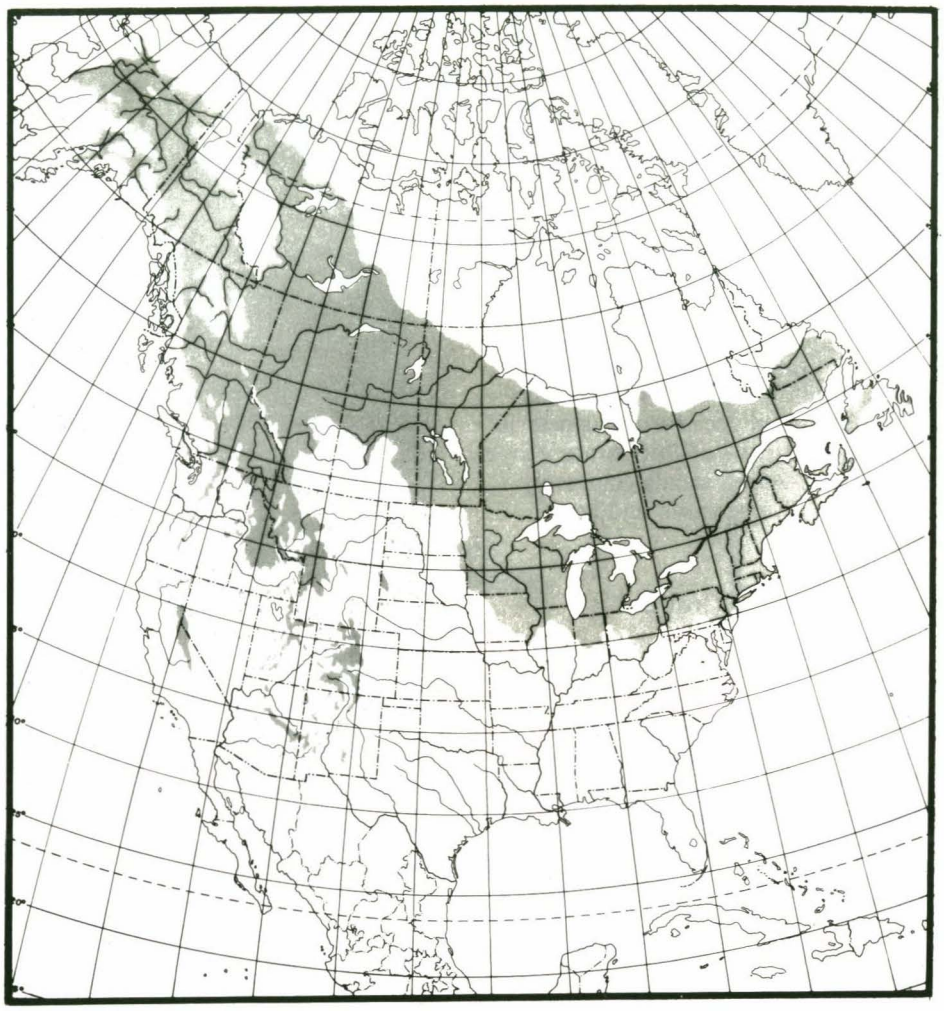

Figure 1—Natural range of quaking aspen.

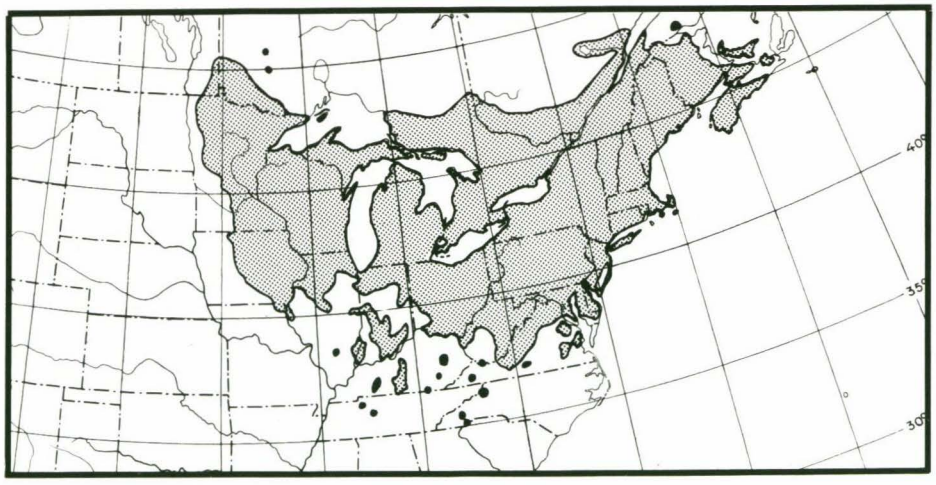

Figure 2—Natural range of bigtooth aspen.

[1] Research Foresters, U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station, St. Paul, MN.

[2] Land capable of producing industrial wood and not withdrawn from cutting by law or regulations. Estimated acreages taken from forest surveys made by Intermountain, North Central, Northeastern, and Pacific Northwest Forest Experiment Stations, USDA Forest Service.

and central Canada. Aspens often are found in stands of northern hardwoods. Well-stocked stands of mixed jack pine and aspen are found on the Precambrian shield in Canada and Minnesota. Scattered aspen groves and individual trees are common in the Engelmann spruce-subalpine fir forests of the Rocky Mountains, and are frequent in the mixed conifer forests of New Mexico and Arizona. At its lower altitudinal limit in the Western States, scrubby aspen are often found in association with oak brush or sagebrush. Prostrate aspen occasionally appear in the flattened mats of tree-shrubs above timberline. Aspen stands commonly have rich diverse shrub and herb layers.

Description and Growth

In aspen, the clone is the biological entity—a multistemmed, vegetatively reproduced individual that may be thousands of years old. Aspen clones owe their ultimate origin to the root system of a single seedling parent, even though they may be several generations removed. Clones are formed when an event such as a fire or cutting destroys the parent, stimulating adventitious sprouts (suckers) to form and grow on the shallow, extensive lateral root system. All clonal members are genetically identical and therefore are similar in appearance. However, clones may differ considerably from one another in leaf, bark, branching, and phenological characteristics. East of the Rocky Mountains, a single clone may cover at most only a few acres—in the West, 100 acres or more. Most aspen stands are a mosaic of several clones.

Aspen trunks generally are fairly straight, have little taper, and are clear of limbs over much of their length; however, limb scars do persist. In some stands, however, aspen trees are very crooked, even contorted, usually from genetic causes.

Bark characteristics of the two species vary. Bigtooth aspen bark (fig. 3) is brownish or yellowish green, whereas quaking aspen bark varies from chalky white to green or olive green. In the Western States, however, the bark sometimes may be yellow brown. The lower trunk of bigtooth aspen usually becomes furrowed with old age. Quaking aspen can vary, however, from little or no furrowing (especially in the West) to furrows 6 to 8 feet high or more. Furrowing can even be intermittent up into the crown.

Figure 3—Bigtooth aspen bark.

Aspen leaves (fig. 4) vary from broadly ovate to nearly round, with slender flattened petioles or stems that cause them to flutter in the slightest breeze. Quaking aspen leaves are from 1¼ to 3 inches wide and lustrous dark green; their margins have small rounded teeth. Bigtooth aspen leaves are typically

larger, and a lighter, duller green; their margins have larger, less rounded teeth. In both species the leaves of young suckers are atypical, and as long as 7 to 8 inches.

Roots usually are abundant in the top 2 to 3 feet of soil. Below that, vertical "sinker" roots often extend to a depth of 5 feet or more, where they penetrate even very hard soil layers.

Aspens are dioecious: that is, the flowers on a single tree are all of the same sex. Seeds borne in slender catkins in the spring are tufted and very light—about 3 million per pound. Good seed crops are produced every 4 or 5 years. Both pollination and seed dispersal are accomplished by wind. Despite the abundance of highly viable seed, seedling establishment is uncommon because newly germinated seedlings require optimum conditions to survive. In contrast, aspen suckers are much more vigorous and may number 5,000 to 30,000 per acre and grow up to 5 feet or more in height the first year (fig. 5).

Aspen, intolerant of overhead shade, normally does not grow beneath a closed canopy of larger trees. Beneath an open canopy of an old deteriorating aspen stand, however, suckers may persist and grow slowly.

The aspens are shorter lived than most associated species. In the Lake States, aspen stands commonly deteriorate and break up by age 60. In the Rocky Mountains, 100-year-old stands are common, and some 200-year-old stands are found.

Pure stands of aspen usually become established only after fire or logging. Other species often replace them in a single generation, but in the Western States, aspen stands may persist through several generations, or even indefinitely, because seed sources of other species are distant or because the environment is only occasionally

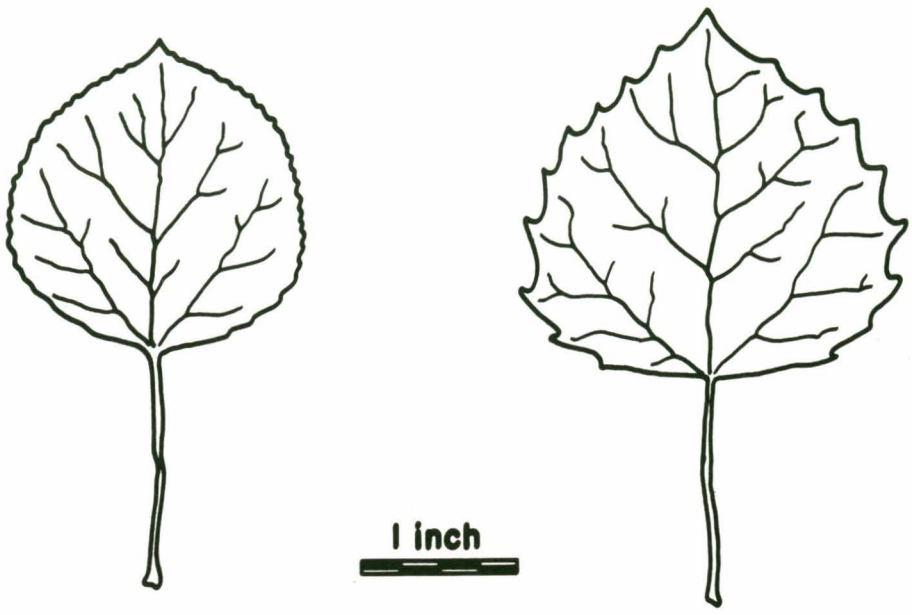

Figure 4—Leaves of quaking aspen (left) and bigtooth aspen (right).

Figure 5—One-year-old bigtooth aspen suckers, Upper Peninsula, MI.

suitable for their establishment.

On medium or better quality sites throughout most of its range, aspen grows more rapidly to maturity than associated species. Exceptionally rapid growth of dominant trees is sometimes encountered—bigtooth aspen averaging 100 feet tall at 54 years (Michigan) and quaking aspen averaging 82 feet tall at 37 years (Minnesota), for example. More typically, dominant aspens in 50-year-old stands in the Lake States average 60 feet tall and 8 to 12 inches in diameter at breast height (4.5 feet) on medium-quality sites. Growth is slower in central Canada and the Western States, but the trees live longer there and become as large. The Arizona stand in the cover photo took 150 years to grow 110 feet tall. The largest aspen reported, grown in Utah, was 120 feet tall and 4 feet in diameter.

Periodically, the forest tent caterpillar defoliates extensive areas of aspen trees in the Lake States. Although few trees die, their growth is temporarily slowed down. A fungus disease, hypoxylon canker, causes most aspen deaths in the Lake States. In the Western States, outbreaks of the western tent caterpillar have killed large stands of aspen. Various cankers, however, cause most mortality.

Deer, elk, or moose browse young aspen sprouts, and where herds are heavily concentrated, repeated browsing may completely eliminate some sucker stands. In the Lake States, large deer herds have sometimes created an economic problem for the forester or landowner who grows aspen for a commercial market.

Common Names

Populus tremuloides, commonly called quaking aspen, is also known as trembling aspen. *Populus grandidentata,* usually called bigtooth aspen, also may be called largetooth aspen. Both species are also called aspen, poplar, and popple. The term ''popple'' or sometimes ''poplar'' should not be confused with yellow-poplar (*Liriodendron tulipifera*), also known in the trade as ''poplar.''

Related Commercial Species

Balsam poplar (*Populus balsamifera*), is included in the sawtimber and pulpwood volumes shown for quaking and bigtooth aspen. This species occurs with aspen throughout much of the range in the Lake States and Northeast.

Supply

The total volume of aspen in the United States is approximately 17 billion cubic feet of growing stock, including about 30 billion board feet in sawtimber-size trees.[3] About 38 percent of the sawtimber and 32 percent of the growing stock is located in the Western States of Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington, and Wyoming. Colorado, New Mexico, and Utah account for 23 percent of the sawtimber and 21 percent of the growing stock. About 47 percent of the sawtimber and 50 percent of the growing stock is located in the Lake States of Michigan, Minnesota, and Wisconsin. The New England States contain about 8 percent of the sawtimber and 10 percent of the growing stock, mostly in Maine, New Hampshire, and Vermont. Recent surveys show aspen volumes to have increased substantially in northern New England where it is now the second most abundant hardwood species in Maine. The Middle Atlantic and Central States contain minor amounts.

Production

Although aspen was used mainly for woodpulp in the past, its use in structural panels and particle board has increased remarkably in the early 1980's. The species is now considered an important and valuable part of the Nation's forest resource. Lumber and pulpwood production are no longer documented by species, but recent data show annual removals from growing stock for aspen to be approximately 280 million cubic feet and from sawtimber slightly over 300 milion board feet.

Lumber and Veneer. Lumber produced from aspen and cottonwood in the New England, Middle Atlantic, Western, and Lake States gradually increased from 1890 to the mid-1950's, but fluctuated widely.[4] The most noticeable increase was from approximately 77 million board feet in 1941 to 209 million board feet in 1955. These dates coincide with wartime and postwar construction demands. Production then tapered off somewhat, but recent data show annual production of aspen sawlogs at approximately 280 million board feet and of veneer logs approximately 30 million board feet, International ¼-inch Log Rule.

Pulpwood and Particle Board. The volume of aspen cut for pulpwood and flake board is considerably greater than that for other primary products. It rose from about 500,000 cords in the 1930's to nearly 2,700,000 cords in 1981.

The Lake States have harvested the most aspen pulpwood for many years; Production increased from around 1 million cords in the early 1950's to 2.4 million cords in 1981. Annual capacity for wafer board and oriented strand board mills in the Lake States, which use aspen almost exclusively, is estimated to be approximately 1,100 million square feet, ⅜ inch basis.

[3] Forest survey units (see footnote 2) define growing stock as volume of trees 5.0 inches and up in diameter and sawtimber size as volume found in trees of 11.0 diameter and up, International ¼-inch Log Rule.

[4] Individual estimates were not available for aspen and cottonwood separately during this time.

Characteristics and Properties

The woods of quaking and bigtooth aspen are similar in appearance and properties. The heartwood is white to light brown; and generally the whiter sapwood blends into the heartwood. The wood is uniform in texture with a small earlywood to latewood density gradient. When dry, the wood is odorless and tasteless, and the annual growth rings have a slightly distinct color difference between earlywood and latewood. The wood is generally straight grained, light and soft with good dimensional stability, and low to moderate shrinkage. Wetwood, a water-soaked condition caused by bacteria in living trees, can cause collapse at the zone between sapwood and heartwood during drying and may require air drying or presorting before kiln drying. Both sapwood and heartwood have low decay resistance and it is somewhat difficult for preservatives to penetrate the wood. Aspen specific gravity averages around 0.38, based on ovendry weight and green volume. Its average weight at 12 percent moisture content is 26 pounds per cubic foot. Aspen has relatively low strength, is moderately stiff, and is moderately low in shock resistance. It seldom splits when nailed. It machines easily to a slightly fuzzy surface, and excellent turnings, borings, and sanded surfaces can be made. The nail-holding ability is poor to fair, but it has excellent gluing qualities and good printability and paint-holding character. Aspen is easily pulped by all commercial processes. Fiber morphology has an excellent length-to-diameter ratio and thin- to medium-walled fibers, making aspen pulp particularly well suited to enhance fine paper structure.

Principal Uses

Pulp products, such as book, newsprint, and fine printing papers, account for considerable aspen usage. Aspen's medium density is especially good for fiberboard products, and it has been the most preferred species for structural wafer board panel manufacture in the United States. These construction panels have found excellent acceptance as a substitute for plywood as sheathing, decking, and in decorative applications. A small volume of aspen is made into studs, but most lumber is remanufactured into boxes, crates, pallets, furniture parts, and lumber core is used for millwork components in place of ponderosa pine. Aspen veneer is used in containers and matchsticks and is especially good for stamped veneer products such as tongue depressors, spoons, or ice cream sticks. Wall and cabinet plywood panels are made in Colorado and Michigan. Specialty uses include excelsior and corral poles. Aspen pellets, especially from bark, have proved to be a nutritive animal feed, and are also used extensively for fuel in the Lake States.

Other Values

There is a close correlation between the distribution of aspens and of ruffed grouse (*Bonasa umbellus*). Aspen leaves and male flower buds constitute the most important yearlong food resources for these birds. Deer and elk commonly browse on the leaves, twigs, bark, and sprouts. The fall foliage provides an esthetically pleasing panorama of golden beauty, especially in the western range.

References

Blyth, James E.; Whipple, James H.; Boelter, Allen H.; Wilhelm, Steven. Lake States primary forest industry and timber use, 1975. Resour. Bull. NC-49. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1980. 39 p.

Blyth, James E.; Smith, W. Brad. Pulpwood production in the north central region by county, 1981. Resour. Bull. NC-69, St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1983. 21 p.

Brinkman, Kenneth A.; Roe, Eugene I. Quaking aspen: Silvics and management in the Lake States. Agric. Handb. 486. Washington, DC: U.S. Department of Agriculture; 1975. 52 p.

DeByle, Norbert V., ed. Part I—Aspen. In: Symposium proceedings, situation management of two Intermountain species: aspen and coyotes; 1981 April 23-24; Logan, UT: Utah State University; 1981. 99 p.

DeByle, Norbert V.; Winokar, Robert, eds. Aspen: ecology and management in the western United States, Res. Pap. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Stations; [in press].

Eyre, F.H., ed. Forest cover types of the United States and Canada. Washington, DC: Society of American Foresters; 1980. 148 p.

Fowells, H.A., comp. Silvics of forest trees of the United States. Agric. Handb. 271. Washington, DC: U.S. Department of Agriculture; 1965. 762 p.

Graham, Samuel A.; Harrison, Robert P., Jr.; Westell, Casey E., Jr. Aspens: Phoenix trees of the Great Lakes region, Ann Arbor, MI: University of Michigan Press; 1963. 272 p.

Jones, John R. Silviculture of southwestern mixed conifers and aspen: the status of our knowledge. Res. Pap. RM-122. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1974. 44 p.

Maini, J.S.; Cayford, J.H., eds. Growth and utilization of poplars in Canada. Dep. Publ. 1205. Ottawa, ON: Department of Forestry and Rural Development, Forestry Branch; 1968. 257 p.

Nevel, Robert L., Jr.; Sochia, Everett L.; Wahl, Thomas H. New York timber industries—a periodic assessment of timber output. Resour. Bull. NE-73. Broomall, PA: U.S. Department of Agriculture, Forest Service,

Northeastern Forest Experiment Station; 1982. 30 p.

Ohmann, L.F.; Batzer, H.O.; Buech R.R.; Lothner, D.C.; Perala, D.A.; Schipper, A.L., Jr.; Verry, E.S. Some harvest options and their consequences for the aspen, birch, and associated conifer forest types of the Lake States. Gen. Tech. Rep. NC-48. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1978. 34 p.

Perala, Donald A. Manager's handbook for aspen in the North Central States. Gen. Tech. Rep. NC-36, St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1977. 30 p.

U.S Department of Agriculture, Forest Service. Aspen: Symposium proceedings. Gen. Tech. Rep. NC-1. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1972. 154 p.

U.S. Department of Agriculture, Forest Service. Utilization and marketing as tools for aspen management in the Rocky Mountains: Proceedings of the symposium. Gen. Tech. Rep. RM-29. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1976. 120 p.

U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. Wood handbook: wood as an engineering material. Agric. Handb. Rev. ed. 72. Washington DC: U.S. Department of Agriculture; 1974. 428 p.

U.S. Department of Agriculture, Forest Service. An analysis of the timber situation in the United States—1952–2030. For. Resour. Rep. 23. Washington, DC: U.S. Department of Agriculture; 1982. 528 p.

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